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A study on the changes in life habits, mental health, and sleep quality of college students due to COVID-19

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Abstract.
BACKGROUND: In early 2020, the coronavirus 2019 (COVID-19) pandemic necessitated changes in social behavior to prevent its spread, including holding online classes, implementing social distancing, and allowing employees to telecommute. However, these changes have had a negative impact on people's sleep patterns and mental health, particularly for college students.
OBJECTIVE: This study investigated the relationship between mental health and sleep quality according to the changes in lifestyle of college students in the periods before and after COVID-19.
METHODS: The study subjects were 164 college students from Korea who had both face-to-face and non-face-to-face college experiences before and after COVID-19. The experiment was conducted using a Google survey, and the participants were recruited from the college community. The general features and lifestyle habits for the individuals were assessed using the AUDIT-K, Delphi method, KGHQ (General Mental Health Scale), and PSQI-K (Pittsburg Sleep Quality Index).
RESULTS: The KGHQ and PSQI scores increased with the spread of COVID-19, which means that the mental health and sleep quality of college students deteriorated. 11 categories of variables were further investigated to evaluate changes in lifestyle, and the results indicate significant changes in the number of private meetings per week, monthly drinking, outdoor activity time, electronic device usage time, weekly food delivery, weekly late-night snacks, daily snacks, and daily coffee intake and no significant changes in exercise, smoking, and fast food intake.
CONCLUSIONS: COVID-19 caused many changes in the lifestyle of college students, which adversely affected mental health and sleep.

Keywords: Coronavirus, university students, mental health, sleep quality, lifestyle habits, Korea

1. Introduction

Coronavirus 2019 (COVID-19) triggered widespread changes in social behavior in early 2020, including classes conducted online, social distancing measures and telecommuting to work. These changes were aimed to prevent the spread of the virus, and the borders between work, study, and rest crumbled as a result of these. In particular, opportunities for positive emotional exchange in face-to-face interactions were considerably reduced compared to the time period before COVID-19 [1].

The quality of sleep of the Korean population has deteriorated since the start of the COVID-19 pandemic. According to a Philips worldwide sleep survey of 13,000 people in 13 countries, including

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999 Koreans, 62% of Koreans have sleep problems resulting from stress, and their sleep satisfaction of 40% is lower than the global average of 55%. According to Bhat and Chokroverty [2], an increase in sleep disorders is associated with COVID-19, including insomnia and excessive sleepiness. The blurry line between personal and professional life, excessive coffee consumption, late-night screen time, overtime, and procrastination may cause an increase in the incidence of sleep disorders. Also, varying shift schedules make potentially debilitating effects upon sleep quality and the subjective state of physical and mental health [3, 4].

Lifestyle and food habits significantly affect depression, which is a common mental illness. Joo et al. [5] described the relationship between leisure activities and depression in young people after COVID-19, and Mawi et al. [6] discovered that continuous use of mobile devices and shopping behavior had a strong correlation with depression, anxiety, and stress. The number of individuals showing depressive symptoms has also increased dramatically with COVID-19. The number of patients in their 20 s with depression increased drastically from 121,047 for all of 2019 to 94,290 in just the first half of 2020, which is a very rapid increase considering that in 2018, the number of patients in their 20 s with depression was 99,778 [1].

Compared to the overall population, COVID-19 has had the greatest impact on sleep quality and mental health of college students, and this is due to college students showing the greatest variation in their activities before and after COVID-19. Despite COVID-19, office workers can inevitably work from home while also going to work. In addition, despite that South Korea implemented third- and fourth-phase distancing measures in response to the growth of COVID-19, elementary, middle, and high schools have resumed face-to-face classes since these are considered "essential acts for everyone" [7]. As such, it is more difficult for college students to live a normal life than it is for office professionals, primary, middle, and high school students. Therefore, college students have become more prone to depression and poor sleep. Sara et al. [8] found that COVID-19 caused them to feel the effects of their sleep time, sleep latency, wake-up time, sleep quality, and insomnia more than office workers.

Furthermore, before COVID-19, college students were able to participate in face-to-face activities such as club activities and face-to-face classes, and the frequency of remote activities has increased in a variety of ways due to the government's distancing policies. College students have noticed a difference in their surroundings, and Kang et al. [9] found that college students experienced psychological, contextual, and behavioral changes resulting from COVID-19. Moreover, numerous behaviors including drinking, coffee consumption, and nutritional supplies might negatively impact the sleep quality of college students [10].

There are several studies that investigate the impact of COVID-19 on college students' lifestyle, depression, and sleep, including Bhat and Chokroverty's study on sleep dysfunction, Ju et al.'s study on depression, Sara et al.'s study on sleep and psychoemotional changes, and Kang et al.'s study on overall on college students. Previous studies on sleep quality and perceived stress levels of nurses working in hospitals during the COVID-19 pandemic also exist [11]. However, the relationship between sleep quality and mental health corresponding to changes in lifestyle among college students has not yet been investigated. Bu et al. indicated that college students are more likely than others to be exposed to mental risk factors during social isolation, and the goal of this study is to look into the relationship between mental health and sleep quality in college students before and after COVID-19 as a result of changes in lifestyle behaviors.

2. Method

2.1. Subjects

This study was conducted with Korean college students who had both face-to-face and non-face-to-face college experiences before and after COVID-19. We recruited participants from the student community, and a survey was conducted using a Google questionnaire. The subjects of the study include 164 students (85 female, 79 male) who responded to the survey from May 6, 2021 to April 19, 2022. A total of 250 college students participated in the survey, and data of 86 respondents who did not complete the response or were not sincere were excluded from the analysis. The average age of the participants was 24.15 years, and the standard deviation was 1.76.

2.2. Data analysis method

The survey collected demographic data (gender, age, school number, and dwelling type) and lifestyle

Table 1
KGHQ questions

KGHQ questions	Scale
1. Were you able to concentrate well on what you are doing?	4-point Likert scale
2. Have you ever had trouble sleeping because of worry?	“
3. Did you feel you were performing a useful role in many ways?	“
4. Were you able to make the right decisions in every case?	“
5. Have you ever felt constantly tense?	“
6. Have you ever felt that you couldn't overcome the difficulties?	“
7. Were you able to enjoy your daily activities?	“
8. Did you try to solve the problem by confronting it rather than avoiding?	“
9. Have you ever felt depressed and unhappy?	“
10. Did you feel less confident?	“
11. Did you go out as often as before?	“
12. Have you ever felt that life was hopeless?	“
13. Have you ever felt difficulties because of something that bothers you?	“
14. Do you often have trouble sleeping at night?	“
15. When you did something, were you able to handle it as well as most other people did?	“
16. Could you feel the warmth and affection for those close to you?	“
17. Did you feel hopeful for your future?	“
18. Were you able to live diligently and concentrate on your work?	“
19. Did you find it not difficult to get along with others?	“
20. Did you feel you were doing a good job overall?	“

habits (exercise, interpersonal relations, drinking and smoking, presence or absence of external activities, electronic device use, and dietary habits). We used the AUDIT-K (alcohol use disorder screening test) for drinking [12, 13], and the Delphi method was used in the construction of a questionnaire to evaluate the dietary habits [14]. We assessed the mental health and sleep quality of college students using the KGHQ (General Mental Health Scale) and PSQI-K (Pittsburg Sleep Quality Index), which are the most often used scales. Following Shin [15] and Lee and Cho [16], the KGHQ consisted of a total of 20 questions, including 5 questions measuring ‘anxiety,’ 4 questions measuring ‘depression,’ and 1 question measuring ‘social maladjustment.’ We used ‘GHQ scaling’ and asked subjects to react on a 4-point Likert scale of ‘always’, ‘sometimes’, ‘rarely’, and ‘never.’ The scores range from 0 to 20, and we set the split score at 13 points, which serves as a guideline to determine which people are at risk for mental illness. A higher score indicates worsening levels of mental health. Anxiety factors (No. 2, 5, 12, 19, 20), depression factors (No. 6, 9, 10, 11, 16), social maladjustment (No. 1, 3, 4, 7, 8, 13, 14, 15, 17), and frequency of going out (No.11) were the four types of sub-factors. (Table 1)

PSQI-K includes 19 self-evaluation questions and 5 questions of a person sleeping together. However, in this study, in consideration of the uncertainty of participants' memory before COVID-19, the evaluation questions of people sleeping together were excluded (Table 2). The responses to self-evaluation questions are combined to produce seven component scores, each having a range of 0–3 points. In all cases, ‘0’ points indicate that there is no difficulty, and ‘3’ points indicate serious difficulty. Seven component scores are added to make one overall score with a range of 0–21. A score of 0 indicates that there is no difficulty, and a score of 21 indicates that there are serious difficulties in all areas (Table 3). PSQI can be used to classify participants into ‘bad sleepers’ and ‘good sleepers’ by evaluating the subjective sleep quality. If the score is 5 or more, there are considered as ‘having a sleep problem.’

For the analysis, categorical data (meal regularity) was evaluated using the chi-square test in the SPSS program. We analyzed continuous data (exercise, human relations, drinking and smoking, outdoor activity time, electronic device usage time, delivery food, late-night snack, coffee, and fast food) with a paired comparison *t*-test in Excel.

3. Results

3.1. Assess changes in sleep status and mental health

Tables 1 and 2 show the results for KGHQ and PSQI scores through a paired comparison t-analysis before and after COVID-19. The KGHQ score increased 3.5 points from about 5.6 points before COVID-19 to about 9.1 points for the period

Table 2
PSQI-K questions

Questions	Answer
1. During the past month, when have you usually gone to bed at night?	Usual bedtime
2. During the past month, how long has it usually taken you to fall asleep each night?	Number of minutes
3. During the past month, when have you usually gotten up in the morning?	Usual wake up time
4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spend in bed.)	Hours of sleep per night
5. During the past month, how often have you had trouble sleeping because of following reasons?	Not during the past month/Less than once a week/Once or twice a week/Three or more times a week
5-a. cannot get to sleep within 30 minutes	‘’
5-b. wake up in the middle of the night or early morning	‘’
5-c. have to get up to use the bathroom	‘’
5-d. cannot breathe comfortably	‘’
5-e. cough or snore loudly	‘’
5-f. feel too cold	‘’
5-g. feel too hot	‘’
5-h. had bad dreams	‘’
5-i. have pain	‘’
5-j. Other reasons, please describe. How often during the past month have you had trouble sleeping because of this?	‘’
6. During the past month, how would you rate your sleep quality overall?	Very good/Fairly good/Fairly bad/Very bad
7. During the past month, how often have you taken medicine (prescribed or “over the counter”) to help you sleep?	Not during the past month/Less than once a week/Once or twice a week/Three or more times a week
8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	Not during the past month/Less than once a week/Once or twice a week/Three or more times a week
9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	No problem at all/Only a very slight problem/Somewhat a
10. Do you sleep in the same bed or share a house with others?	No bed partner or roommate/Partner or roommate in other room/Partner in same room, but not same bed/Partner in same bed

after the start of COVID-19. The mental health of college students was adversely affected after the start of COVID-19, since the higher score indicates a deterioration in mental health ($p < 0.05$). The PSQI-K score increased by 1.48 points from 5.98 points before COVID-19 to about 7.46 points after COVID-19 ($p < 0.05$). The quality of sleep is considered to exhibit problems at 5 points or more, and an increase of 1.48 points indicates that sleep quality worsened.

3.2. Evaluation of changes in lifestyle habits

The survey included variables in 11 categories for regularity of meals, weekly exercise, daily smoking, weekly fast-food intake, weekly private meetings, monthly drinking, outdoor activity time, electronic device usage time, weekly delivery food orders, weekly late-night snack orders, and daily coffee intake. Among these, the regularity of meals, number of private meetings per week, number of drinking hours per month, outdoor activity hours, electronic device usage hours, number of food delivery orders, number of late-night snacks per week, and number of coffee consumed per day showed significant changes before and after COVID-19 (Table 8, 9).

Prior to COVID-19, 65.8% ate regularly and 34.2% ate irregularly. However, after COVID-19, the number of people eating irregularly increased (48.8% and 51.2%, respectively) (Table 6). In addition, the chi-square test confirmed ($p < 0.05$) a significant increase (Table 7).

The interpersonal relationships were investigated using the number of private meetings per week. The number of private meetings in a week decreased from 3.07 before COVID-19 to 1.94 after the spread, which is a large change of 1.13 fewer meetings ($p < 0.05$).

Lifestyle habits related to drinking, outdoor activities, use of electronic devices, exercise, and smoking were also investigated. The number of times drinking per month was investigated, and it decreased by 2.64, from 4.83 times before COVID-19 to about 2.19 times after COVID-19 ($p < 0.05$), which is a

Table 3
PSQI-K component scoring questions

Component 1: Subjective sleep quality	Examine question #6, and assign scores as follows:	Very good (0)/Fairly good (1)/Fairly bad (2)/Very bad (3)
Component 2: Sleep latency	Examine question #2, and assign scores as follows: Examine question #5a, and assign scores as follows: Add #2 score and #5a score Assign component 2 score as follows:	≤15 minutes (0) / 16–30 minutes (1) / 31–60 minutes (2) />60 minutes (3) Not during the past month (0)/Less than once a week (1)/Once or twice a week (2)/Three or more times a week (3) Sum of #2 and #5a 0(0)/1∼2(1)/3∼4(2)/5∼6(3)
Component 3	Examine question #4 and assign scores as follows:	
Component 4 : Habitual sleeping effects	Write down the number of sleeping hours. (Question #4) Describe the time you spent in the bedroom. Calculate the habitual sleep efficiency as follows. Evaluate component 4 as follows:	 Time to wake up (Question #3): _____ Sleeping time (Question #1): _____ Time spent in the bedroom: _____. (Sleeping time/Time spent in the bedroom) X100 = Habitual sleep efficiency (%) (_____/_____) X 100 = _____% Habitual sleep efficiency (%) 85% or more (0)/75–84% (1)/65–74% (2)/65% or less (3)
Component 5 : Sleep disturbance	Check #5b-#5 j and rate each question as follows: Add the scores for questions #5b-5 j. Evaluate the score for component 5 as follows	Not in the past month (0)/ Less than once a week (1)/Once or twice a week (2)/Three times a week or more (3) The sum of #5b-5 j is 0(0)/1∼9(1)/10∼18(2)/19∼27(3)
Component 6: Using sleeping pills	Examine question #7 and assign scores as follows:	None in the past month (0)/No more than once per week (1)/Once or twice per week (2)/More than three times per week or more (3)
Component 7 : Daytime sleep dysfunction	Examine question #8 and assign scores as follows: Examine question #9 and assign scores as follows: Add #8 and #9 points Evaluate the score for component 7 as follows	None in the past month (0)/No more than once per week (1)/Once or twice per week (2)/More than three times per week There was no problem (0)/Only a small problem (1)/There were some problems (2)/There was a very big problem (3) The sum of #8 and #9 0(0)/1/2(1)/3∼4(2)/5∼6(3)
Total PSQI score	Add up all seven component scores	

Table 4
Changes in KGHQ before and after COVID-19

Category	Before & after	Mean	Variation	t-Statistics	*p*-value
KGHQ score	Before	5.61	9.07	–10.699	$P < 0.001$
	After	9.07	17.27		

Table 5
Changes in PSQI-K before and after COVID-19

Category	Before & after	Mean	Variance	t-Statistics	*p*-value
KGHQ score	Before	5.98	8.46	–4.32	$P < 0.001$
	After	7.46	10.73		

Table 6
Changes in the regularity of meals before and after COVID-19

		Regularity of meals. (After COVID-19)				Total
		Very regular	Regular	Irregular	Very irregular	
Regularity of meals. (Before COVID-19)	Very regular	9	2	10	0	12.8%
	Regular	6	39	35	7	53.0%
	Irregular	1	19	20	8	29.3%
	Very irregular	1	3	1	3	4.9%
Total		10.4%	38.4%	40.2%	11.0%	

Table 7
Chi-square test for changes in regularity of meals

	Value	Degree of freedom	Significance probability
Pearson chi-square	245.521	16	<0.001

Table 8
Categories showing significant changes before and after COVID-19

Category	Before & after	Mean	Variance	t-Statistics	*p*-value
The number of private meetings per week	Before	3.07	1.94	15.54	0.00
	After	1.48	1.35		
Monthly drinking	Before	4.83	27.52	6.99	0.00
	After	2.19	11.70		
Outdoor activities	Before	4.08	5.03	16.23	0.00
	After	2.02	2.96		
Electronic device usage time	Before	4.80	6.62	–15.40	0.00
	After	7.26	9.13		
The number of delivery foods per week	Before	1.8	1.17	–10.20	0.00
	After	2.33	2.49		
The number of late-night snacks a week	Before	1.48	1.94	–3.30	0.0012
	After	1.85	3.56		
The number of snacks a day	Before	1.24	1.38	–4.68	0.00
	After	1.71	2.40		
Daily coffee intake	Before	0.85	1.09	–3.25	0.0014
	After	1.19	2.68		
The number of exercises per week	Before	2.02	2.68	–3.05	0.0026
	After	2.52	3.92		
The number of times of fast-food intake per week	Before	1.69	1.33	–2.16	0.0319
	After	1.93	2.23		

Table 9
Categories that have not changed significantly before and after COVID-19

Category	Before & after	Mean	Variance	t-Statistics	*p*-value
Smoking per day	Before	1.44	16.58	–0.80	0.43
	After	1.68	20.02		

large reduction of about 50%. Daily outdoor activity time also decreased significantly. The outdoor activity time decreased by about 2.06 hours from 4.08 hours before COVID-19 to 2.02 hours after COVID-19 ($p < 0.05$). Through this, the time spent at home can be assumed to have also increased with COVID-19. The daily use of electronic devices increased significantly by about 2.46 hours, from 4.8 hours before COVID-19 to 7.26 hours after ($p < 0.05$).

Dietary habits were also investigated as the number of people remaining at home increased. The number of times to order food delivery during a

Table 10
Correlation between gender and changes in sleep status, mental health and lifestyle habits

Variables	DF	F	*p*-value
The number of private meetings per week	1	0.444	0.506
Monthly drinking	1	0.79	0.375
Outdoor activities	1	0.016	0.9
Electronic device usage time	1	0.922	0.338
The number of delivery foods per week	1	0	0.993
The number of late-night snacks a week	1	2.638	0.105
The number of snacks a day	1	0.685	0.409
Daily coffee intake	1	0.152	0.697
The number of exercises per week	1	0.387	0.534
The number of times of fast-food intake per week	1	2.313	0.129
Smoking per day	1	0.324	0.57
Regularity of meals	1	0.918	0.339
KGHQ score	1	0.283	0.595
PSQI-K score	1	1.811	0.179

week increased by 1.05 times, from about 1.28 times before COVID-19 to about 2.33 times after COVID-19 ($p < 0.05$). Before COVID-19, late-night snacks were eaten about 1.48 times a week, but after COVID-19, it increased about 0.37 times to about 1.85 times. Although this is an increase of 0.37, the change can be considered significant since the variation has a large spread ($p < 0.05$). The number of snacks a day also increased from 1.24 before COVID-19 to 1.71 after COVID-19, up about 0.47 times ($p < 0.05$). The coffee intake per day, which is related to sleep quality, increased from about 0.85 before COVID-19 to about 1.19 after COVID-19, about 0.34 times ($p < 0.05$).

There were no significant changes in exercise frequency, smoking, and fast-food intake per week (Table 6). The exercise frequency increased slightly due to COVID-19, but it can be said to be almost the same ($p > 0.05$). Smoking frequency did not show changes related to COVID-19 ($p > 0.05$).

3.3. Correlation between gender and changes in sleep status, mental health and lifestyle habits

As a result of univariate ANOVA, it was found that the interaction was not significant in all categories according to gender and COVID-19 ($p < 0.05$) (Table 10).

4. Discussion

The KGHQ scores increased significantly from an average of 5.61 points before COVID-19 to an average of 9.07 points after COVID-19, which means that college students' mental health decreased with an increase in depressive symptoms and lethargy. The time of use of electronic devices has an effect because excessive use of electronic devices disturbs human biological rhythms due to the artificial lighting of electronic devices, causing sleep disorders, and resulting in adverse effects on mental health. In a survey of 221,096 adolescents, users with less than one hour of electronic device usage per day were much more psychologically healthy than those with more than five hours per day [17]. In this study, the use of electronic devices increased significantly from an average of 4.8 hours before COVID-19 to 7.26 hours after COVID-19, and there was a significant deterioration in mental health scores.

The time spent excluded from social activities also influences mental health. Private meetings or leisure activities can reduce anxiety and improve mental health [18]. This study found that college students' number of private meetings decreased by 51%, outdoor activity time decreased by 50%, and there is a corresponding decrease in mental health.

The PSQI score related to sleep of college students in this study changed from an average of 5.98 points before COVID-19 to an average of 7.46 points after COVID-19, which means that the quality of sleep deteriorated. The first change in lifestyle that affects this is daily coffee intake. Caffeine is a neuroactive substance and is known to have a negative effect on sleep by blocking certain chemical bonds in the brain that feel tired [19]. This study found an increase in college students' daily coffee intake of 29% compared to that before COVID-19, and the increased daily coffee intake had a negative effect on sleep quality.

The second factor is the time of use of electronic devices. Excessive use of electronic devices can disrupt human biological rhythms due to the artificial lighting of the electronic devices that adversely affects sleep quality. Jin and Pae reported that 40.5% of individuals in their sleeping group used their smartphones for 2 to 4 hours and 48.8% for the non-sleep group, higher than in the sleeping group by 33.3% [20]. The results of this survey showed that college students' time using electronic devices increased by 34% compared to before COVID-19. This change can be seen as a factor that contributed to the deterioration of sleep quality.

The third factor is an irregular eating pattern. People with low sleep quality were more likely to have irregular eating patterns than those with higher sleep quality [21] and eating at night was found to be negatively related to sleep quality [22]. This study found a higher rate of eating food at night together with a lower quality of sleep.

The fourth factor is the frequency of outdoor activities. Outdoor activities are greatly related to exposure to natural light. Natural light regulates physiological rhythms, of which sleep is the most relevant, and receiving high levels of natural light is associated with reduced depression and improved sleep quality [23]. The number of outdoor activities decreased by 50% compared to before COVID-19, which negatively affected the mental health and sleep quality of college students.

As described above, COVID-19 changed many lifestyle habits of college students, which negatively affected mental health and sleep quality. The increase in electronic device use, decrease in private meetings, and decrease in external activities deteriorated mental health, and the increase in coffee intake per day and increase in electronic device use deteriorated the quality of sleep. Furthermore, Hamilton et al. found that sleep quality was associated with psychological and mental factors [24]. Therefore, there is a possibility that COVID-19 not only adversely affects sleep quality and mental health, but also creates a vicious cycle in which a deterioration in sleep quality negatively affects mental health and a deterioration in mental health negatively affects sleep quality.

We compared our results with those of related studies. Browning et al. used a web-based questionnaire to study the psychological effects of COVID-19 on 2,534 university students (college and graduate) from seven universities in the United States and found that students who spent more than two hours outside and less than eight hours using electronic devices had less deterioration in mental and psychological health [25]. This is similar to our finding that a reduction in outdoor activity and increased use of electronic devices due to COVID-19 negatively affected mental health. In addition, Xiang et al. studied the scale of anxiety and depression caused by COVID-19 for 1,396 Chinese college students and reported that high-level physical activity was closely related to low anxiety caused by COVID-19 [26]. In this study, there was no difference in exercise, but similar results were observed due to the significant difference in outdoor and social activities.

This study was conducted on college students enrolled nationwide, but since the gender ratio is somewhat unbalanced and most of the students live in specific areas of Korea, further studies are needed to generalize the results. In addition, future studies that can supplement lifestyle changes caused by COVID-19 beyond the specific habits of this study to provide more robust statistical analysis of the differences between groups before and after COVID-19.

5. Conclusion

This study showed the changes in mental health and sleep caused by changes in the lifestyle of college students due to COVID-19. Unlike previous studies, the relationship between mental health and sleep was more significant when considering the lifestyle changes before and after COVID-19. The number of private meetings per week, monthly drinking hours, outdoor activity hours, electronic device usage hours, week delivery food orders, week late-night snack orders, daily snack intake, and daily coffee intake increased, showing significant changes. These changes in lifestyle seem to have negatively affected the quality of sleep and mental health of college students as a consequence of COVID-19.

Despite vaccination, the increase in confirmed COVID-19 cases has not been dampened, and social distancing due to COVID-19 is likely to continue into the future. Therefore, as this study suggests, there is a concern that mental health and sleep quality of college students will continue to deteriorate. To solve this problem, it is necessary to improve the lifestyle habits shown in this study to contribute to significant changes. Therefore, the results of this study can help improve the overall mental health and sleep quality of college students and are expected to be applica-

ble to various fields including counseling therapy and sociology.

Ethical approval

The Institutional Review Board of Kyung Hee University approved the study (No. KHSIRB-17-023).

Informed consent

Informed consent was obtained from all individual participants included in the study.

Conflict of interest

None to report.

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